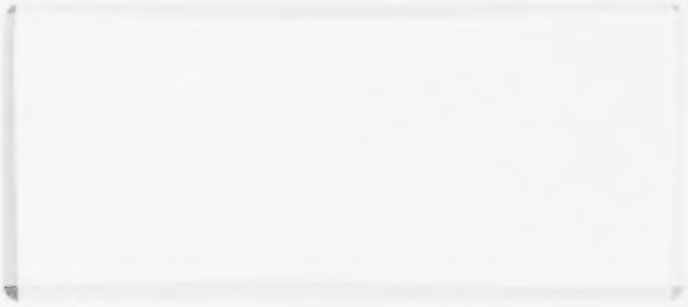
MACKENZIE MOUNTAIN NON-RESIDENT AND NON-RESIDENT ALIEN HUNTER HARVEST SUMMARY 2005

Northwest Territories Resources, Wildlife & Economic Development



MACKENZIE MOUNTAIN NON-RESIDENT AND NON-RESIDENT ALIEN HUNTER HARVEST SUMMARY 2005

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ABSTRACT

Each of the 8 licensed outfitters and Renewable Resource Officers from the Sahtu and Dehcho Regions, Department of Environment and Natural Resources (ENR), collected data on big game harvest in the Mackenzie Mountains during the 2005 hunting season. Harvest data and observations of wildlife from non-resident and non-resident alien hunters (collectively called 'non-resident' for this report) were recorded. For 2005, non-resident licences were bought by 394 hunters. This is the greatest annual number of licences sold to non-resident hunters to date. From 1991 to 2004 between 321 and 387 non-resident licences were sold annually. Hunters (n=325) from outside Canada (non-resident aliens) were primarily from the USA (n=291) and comprised 82% of the outfitted hunters; 14 of the 26 European hunters were from Germany. There were 69 Canadian hunters (18%) from outside the Northwest Territories (NWT) (non-residents). Of the 394 non-resident licence holders, 372 came to the NWT and most spent at least some time hunting. Of 246 tags purchased for Dall's sheep, 203 rams were harvested (including 2 by resident hunters). The average annual harvest of rams over the past 15 years has been 197.4. The average age of harvested rams was 10.2 $\pm$ 1.9 years; the 18th consecutive year the average age of harvested rams from the Mackenzie Mountains has been 9.5 years or older. Hunters reported seeing an average of 9.6 legal rams (horns at least ¾ curl) during their hunts and observed an estimated 51.3 lambs and 98.0 rams per 100 ewes, respectively. This is the highest ram:ewe ratio reported compared with a mean of 84:100 during 1995-2004. Of 285 tags purchased for mountain woodland caribou, 160 bull caribou were harvested. Hunters observed an estimated 42.4 caribou calves and 41.6 bulls per 100 adult female caribou, respectively. Of the 101 tags purchased for moose, 74 bull moose were harvested. This is the greatest harvest of moose recorded; from 1991-2004 the average annual moose harvest was 46 (range 32-55). However this was also the year with the greatest number of licences sold. Hunters observed an estimated 32.5 moose calves and 110.2 bulls per 100 adult female moose, respectively. Of the 40 tags purchased for mountain goat, 18 goats were harvested; 16 billies and 2 nannies. This is the greatest harvest of mountain goats recorded; from 1991-2004 the average annual mountain goat harvest was 4 (range 1-9), but this year had the highest number of licenses sold. Hunters observed an estimated 66.0 goat kids and 50.4 billies per 100 adult nannies. Nineteen wolves were harvested from 214 tags purchased, the greatest harvest of wolves recorded. From 1991-2004 the average annual wolf harvest was 13 (range 7-18). One wolverine was harvested from 154 tags purchased. The number of wolverines observed by hunters in 2005 was similar to 2004 and during 1995-1999, being up substantially from years 2000-2003. All observed wolverines were alone this year, no family groups were seen. No black bears were harvested from 40 tags purchased. There has been no grizzly bear hunting season for non-residents since 1982. Hunter satisfaction remains high, with 97% of respondents rating their experience as either excellent (90%) or very good (7%). A number of hunters made specific comments about the high quality hunting experience and the abundance of wildlife in the Mackenzie Mountains. Of 256 respondents, 42% indicated that they would like to return in future years and 34% were repeat clients, returning for their 2nd to 19th hunt in the Mackenzie Mountains. Unfortunately the percentage of Voluntary Hunter

Observation Forms returned was 65% which was down from 2004. At least 9700 kg of wild game meat, mostly moose and caribou, was reported distributed locally in 2005. Replacement cost of meat from local northern retailers is conservatively about $200,000.

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INTRODUCTION

The 140 000 km^2 (54 000 mi^2; 34.6 million acres) area of the Mackenzie Mountains in the western Northwest Territories (NWT) were first opened to non-subsistence hunters in 1965 (Simmons 1968). Since then, the Mackenzies have become world-renowned for providing a high quality wilderness hunting experience, particularly for Dall's sheep (Veitch and Simmons 1999). In return, non-resident hunters and outfitters in the Mackenzie Mountains provide an estimated $1.8 million annually to individuals, businesses, and governments in the NWT (EXCELeration Corp. 2000). The outfitted hunting industry in the Mackenzie Mountains also provides employment for 100 to 120 outfitters, guides, pilots, camp cooks, camp helpers, and horse wranglers (Kelly Hougen, President, Association of Mackenzie Mountain Outfitters personal communication). Additionally, fresh meat from many of the harvested animals is provided to a number of local communities including Tulita, Fort Good Hope, and Norman Wells in the Sahtu and Nahanni Butte, Fort Liard and Fort Simpson in the Dehcho. This meat is distributed among local elders and residents and to health/long term care facilities.

Eight outfitters are currently licenced by the Government of the Northwest Territories (GNWT) to provide big game outfitting services within the Mackenzie Mountains (Fig. 1; Appendix 1). No hunting is permitted within the boundaries of Nahanni National Park Reserve in the southern half of the range, except for subsistence harvest by NWT General Hunting Licence holders. Under the terms of the NWT *Wildlife Act*, each licensed outfitter has the exclusive privilege to provide services within their zone, which enhances the outfitters' ability to practice sustainable harvest through annual allocation of the harvest effort.

The hunting licence year in the NWT runs from 01 July to 30 June and those who desire to hunt big game within the NWT must annually obtain a big game hunting licence and must be at least 16 years old (Department of Environment and Natural Resources 2005). There are four classes of licenced big game hunters in the NWT:

1) *General* – subsistence harvesters, primarily aboriginal people.

2) *Resident* - Canadian citizens or landed immigrants who have been living in the NWT for at least two consecutive years prior to application for the licence;

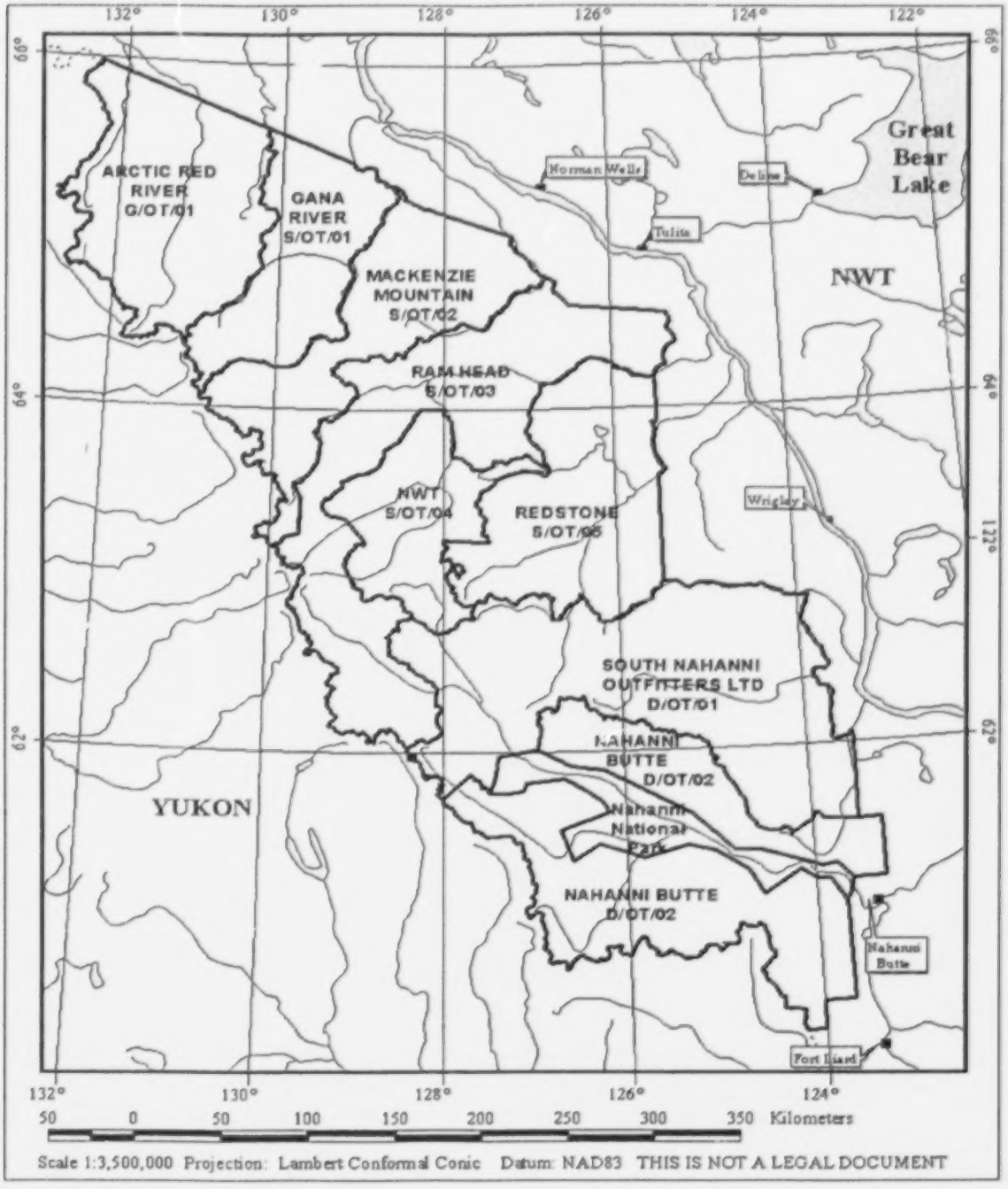

Figure 1. Outfitting zones in the Mackenzie Mountains, Northwest Territories – 2005.

3) *Non-resident* - Canadian citizens or landed immigrants who live outside the NWT, or have not resided in the NWT for a full two years prior to application for the licence.

4) *Non-resident Alien* - an individual who is neither an NWT resident nor a non-resident.

Both non-residents and non-resident alien hunters must use the services of an outfitter and must be accompanied by a licenced guide at all times while hunting big game. For simplification in this report, we call both non-resident and non-resident alien hunting licence holders 'non-residents' and combine their harvest statistics. The data from 2 resident hunters, who harvested Dall's sheep in the Mackenzie Mountains, have been included in the number of sheep harvested and the age and horn length measurements in this report as noted.

Individual non-resident hunters are annually restricted to one each of the following big game species (Appendix 2): Dall's sheep (male with at least ¾ curl horns), mountain woodland caribou (either sex), moose (either sex), mountain goat (either sex), wolf (either sex), wolverine (either sex), and black bear (adult not accompanied by a cub or cubs). Non-resident hunting for grizzly bears was closed in 1982 as a result of concerns about over-harvest (Miller et al. 1982; Latour and MacLean 1994). There are currently no restrictions on the total number of each big game species that an outfitter can take within the zone for which they are licenced.

Wildlife management within the Mackenzie Mountains is the responsibility of a variety of government agencies and boards set up as a result of comprehensive land claim agreements. The Nahanni National Park Reserve (4766 km^2) in the south Mackenzie Mountains is managed by Parks Canada – an agency of the Canadian federal government. Under the terms of the Sahtu Dene and Metis Comprehensive Land Claim Agreement (signed in 1993) and the Gwich'in Comprehensive Land Claim Agreement (signed in 1992), primary responsibility for wildlife management within the two settlement areas lies with the Sahtu Renewable Resources Board (SRRB) and the Gwich'in Renewable Resource Board (GRRB), respectively. Approximately 68 000 km^2 of the central and northern Mackenzie Mountains are within the Sahtu Settlement Area and 8300 km^2 are within the Gwich'in Settlement Area, which encompasses the

extreme north end of the range. However, the GNWT maintains ultimate jurisdiction for management of wildlife and wildlife habitat within each of the claim areas. The Department of Environment and Natural Resources (ENR), formerly the Department of Resources, Wildlife & Economic Development (DRWED) of the GNWT is responsible for licencing outfitters, guides, and hunters and for annually monitoring non-resident big game harvest in the Mackenzie Mountains. Under the terms of the Dehcho First Nations Interim Measures Agreement (signed in 2001), ENR has primary responsibility for wildlife management within the Dehcho region (approximately 59 000 km^2) of the southern half of the Mackenzie Mountains.

Each year ENR, under provisions in the GNWT's *Wildlife Business Regulations*, requires that outfitters submit an Outfitter Return on Client Hunter Success form for each person that purchased a NWT non-resident big game hunting licence (Fig. 2). These are known as outfitter return forms and they must be submitted whether or not a client actually hunted, and whether or not any game was harvested. The outfitter return forms allow us to quantify harvest by non-resident hunters to help biologists with the GRRB, SRRB, and ENR ensure that the harvest of each species is within sustainable limits.

In 1995, DRWED requested that all non-resident hunters also fill out a voluntary questionnaire. The questionnaire has been revised through the years to include different questions pertaining to wildlife observations, the quality of the hunting experience, the quality of services related to hunter travel, and provides an opportunity for specific comments by the hunter. One key component of the questionnaire that has remained throughout the years pertains to reporting the different types and numbers of wildlife seen during their hunts. These data have been recorded and the questionnaire forms have been and will be referred to as hunter observation forms in this report.

This is the eleventh consecutive year that a summary of the data collected by ENR on non-resident hunters in the Mackenzie Mountains has been made. In the text of this document, data for 1995 are found in Veitch and Popko (1996), for 1996 in Veitch and Popko (1997), for 1997 in Veitch and Simmons (1998), for 1998 in Veitch et al. (2000b), for 1999 and 2000 in Veitch and Simmons (2000a;b respectively), for 2001 by Veitch and Simmons (unpublished data), for 2002, 2003 and 2004 in Larter and Allaire (2003; 2004; 2005a, respectively). Additionally, Latour and MacLean (1994)

summarized data for 1979 to 1990. This report compiles the harvest data collected during the 2005 hunting season and compares it with available data collected since 1995.

Department of Resources, Wildlife and Economic Development
Département de Ressources, Faune et Développement économique
Pursuant to the **WILDLIFE ACT** - En Vertu De La **LOI SUR LA FAUNE**

Northwest Territories

OUTFITTER RETURN ON CLIENT HUNTER SUCCESS

RAPPORT DU POURVOYEUR SUR LES RÉSULTATS DE CHASSE D'UN CLIENT

OR 008291

INSTRUCTIONS: This form is to be completed as soon as practicable after the big game animal has been killed and is to be submitted before the 10th day of the following month to the Regional Biologist.
Ce formulaire doit être rempli aussitôt que possible après l'abattage du gros gibier et doit être remis au biologiste régional avant le dixième jour du mois suivant.

OUTFITTER/CLIENT HUNTER - POURVOYEUR/CLIENT CHASSEUR

Outfitter Name - Nom du pourvoyeur	Client Hunter Last Name - Nom de famille du client chasseur	First Name - Prénom	Init.	Hunting Lic. No. - N° du permis de chasse
Arctic Red River Outfitters	Huntsman	Scott	B.	705270

RETURN FOR THE PERIOD OF - RAPPORT MENSUEL POUR

Month/Mois: Sept. /02. 2002

BIG GAME HUNTED - GROS GIBIER CHASSÉ (If none killed, complete "No. of Days Hunted" for each species hunted - Si aucun animal n'a été abattu, remplir la partie «Nombre de jours à la chasse» pour chaque espèce chassée.)

Species - Espèce	Tag No. N° de l'étiquette	No. of Days Hunted Nombre de jours à la chasse	Guide	Guide Lic. No. N° de licence du guide	Kill Date Date de l'abattage D J / M	Latitude D / M	Longitude D / M	Miscellaneous - Divers
WOODLAND CARIBOU CARIBOU DES BOIS	57048	12	TAVIS MOLNAR	009692	21 09	65° 27'	131° 28'	Right Antler Length: Longueur du bois droit: 49 1/8 cm; Left Antler Length: Longueur du bois gauche: 48 1/8 cm
MOOSE ORIGINAL	62651	8	TAVIS MOLNAR	009692	15 09	64° 26'	131° 42'	Widest Antler Spread: Largeur du panache (au plus large) 60 1/8 cm
MOUNTAIN GOAT CHEVRE DE MONTAGNE								Right Horn Length: Longueur de la corne droit: cm; Left Horn Length: Longueur de la corne gauche: cm; Sex - Sexe
POLAR BEAR OURS POLAIRE								Hide Length: Longueur de la peau: cm; Population; Sex - Sexe
BARREN-GROUND CARIBOU CARIBOU DE LA TOUNDRA								Species - Espèce/No. Seen - Quantité aperçue/Sex - Sexe
Other, specify - Autre, préciser								12 Bull Moose
Other, specify - Autre, préciser								21 Cows
Other, specify - Autre, préciser								7 calves
Other, specify - Autre, préciser								7/50 caribou (7356 1/4, <2 calves)
								9 grizzly (4 cubs)
DALL'S SHEEP MOUFLON DE DALL	18536	1	TAVIS MOLNAR	009692	08 09	64° 53'	131° 26'	27 rams 36 ewes/lambs

Tag No. - N° de l'étiquette | Cert. No. - N° de cert. | Disc No. - N° de disque | Right Horn Base: Corne droit à la base: cm | Left Horn Base: Corne gauche à la base: cm | Right Horn Length: Longueur de la corne droit: cm | Left Horn Length: Longueur de la corne gauche: cm | Spread - Largeur entre les cornes | Broomed - Cornes abîmées: Right - Droit; Left - Gauche | Age

COMMENTS - COMMENTAIRES

We are interested in your observations of quantity and quality of wildlife observed, their location, condition, age, sex, species, etc. In addition, please comment on any unusual conditions (i.e. burn, pathogen, etc.) on the harvested animals.

Nous sommes intéressés par vos observations que vous avez faites sur la quantité et la qualité de la faune, sa localisation, sa condition, l'âge, le sexe, les espèces, etc. De plus, vous pouvez faire des commentaires sur les conditions inhabituelles observées sur des animaux abattus (brûlures, corps étranger, etc.).

Arctic Red River Outfitters

OFFICE USE ONLY - RÉSERVÉ AU BUREAU

Export Permit No. - N° du permis d'exportation	Export Permit No. - N° du permis d'exportation	Cites Permit No. - N° du permis CITES
Checked By - Vérifié par	Date 20	
Entered By - Inscrit par	Date 20	

NOTE: This form must be kept up to date and all records relating to the Outfitter Return are subject to inspection by a Wildlife Officer. It is an offence to give false or misleading information in this return.

NOTE : Cette formule doit être à jour. Un agent de la faune a le plein pouvoir de vérifier la justesse de tout ce qui est inscrit sur le rapport du pourvoyeur. Inscrire des renseignements faux ou trompeurs sur ce formulaire constitue une infraction.

Signature: Date: 26/9/2002

OUTFITTER POURVOYEUR OR AGENT

Headquarters - Administration Centrale

6

Figure 2. 2005 Mackenzie Mountain Outfitter Hunt Report Form.

METHODS

Prior to the start of the 2005 hunting season, each outfitter in the Mackenzie Mountains received sufficient copies of the outfitter return and hunter observation forms for all their clients for the year. The *Wildlife Business Regulations* require outfitter returns be returned by the tenth day of the month following the month of the hunt – e.g., for a hunter that was in the field in July, a form must be submitted by the 10th of August. Those forms were submitted to the senior biologist in either the Sahtu or the Dehcho whether or not a client actually hunted and whether or not harvest occurred. In co-operation with ENR Renewable Resource Officers and the outfitters, persistent attempts were made to obtain outfitter return forms for every non-resident that held a big game hunting licence through a Mackenzie Mountain outfitter in 2005.

Data from both the outfitter return forms and hunter observation forms were entered into *Excel 2000* (Microsoft Corporation, Seattle, WA) spreadsheets. Data were cross-checked with the records of sequentially numbered, unique identifier plugs inserted in the horns of legally harvested rams (maintained by ENR offices across the western Northwest Territories), and with the GNWT wildlife *Export Permit* forms to ensure that all data were verified and that the spreadsheets contained all appropriate available data required for the analyses.

We distributed new hunter observation forms in 2005 to ensure all outfitters had the current form, we recorded all observations directly from these hunter observation forms. If we did not receive a hunter observation form but there were wildlife observation data recorded on the outfitter return form, we entered these wildlife observation data. If we received observation information that differed between the hunter observation form and the outfitter return form for the same client we used the data from the hunter observation form. Occasionally we received identical observation data from forms of different hunters. These hunters had the same guides and lengths of hunts and obviously had hunted together. We recorded forms with data that had been provided, but for the wildlife observation analyses only one set of observation data were used because these data represented one set of wildlife observations.

All descriptive statistical analyses were performed using *Excel 2000* (Microsoft Corporation, Seattle, WA). We present means ± standard deviation. Some statistical analyses were performed using Minitab 7.2 software (Minitab Inc, 1989).

RESULTS AND DISCUSSION

Hunters

Big game hunting licences for the Mackenzie Mountains were bought by 394 non-resident hunters in 2005 (Table 1). Of those, 372 came to the NWT and spent some time hunting; 22 either cancelled their hunts, decided not to hunt for themselves but participated with other hunters they knew, or decided not to hunt due to unforeseen complications after arriving in the NWT. In 2005, licence sales to non-resident Canadians increased to 17% from 13% in 2004 and were similar to sales in 2003 (19%). The Canadian dollar has continued to strengthen during 2005, and this year we saw an increased number of Canadian sport hunters, possibly because guided hunts are sold in American dollars. The number of foreign non-resident hunters in 2005 was higher than in 2004 (330 vs 294). For a second year there was an increase in the number of hunters from countries other than the United States which is responsible for some of the increase in foreign hunters in 2005 (Table 1). The change in ownership of South Nahanni Outfitters (D/OT/01) between 2003 and 2004 has resulted in an increased number of European clients. The American dollar was not faring as well against foreign currencies in 2005, which may have made hunts more attractive to non-American foreign clients.

We received all mandatory Outfitter Return forms for the 394 people that purchased non-resident licences. Voluntary Hunter Observation Report forms were received from 256 (65%) of the 394 that did at least some hunting in 2005 (Table 2). Although this is around the average return since 1995 it is a disappointing decrease over the steady increase in returns during previous years and after consensus by outfitters at the 2003 annual general meeting of the Association of Mackenzie Mountain Outfitters to increase the number of Voluntary Hunter Observation Forms returned. Most outfitters have endeavoured to have these forms completed and submitted but unfortunately one zone with a fairly large clientele continues to lag behind in providing returns; we received only 9 of 60 forms from zone S/OT/03 in 2005. To be able to generalize the observations we receive over the entire Mackenzie Mountains it is vital that we have good representation from all outfitting zones.

It is obvious that non-residents immensely enjoy their hunting experience in the Mackenzie Mountains (Table 3) – in 2005, 97% of respondents rated their experience as either excellent (90%) or very good (7%). Voluntary client comments made specific mention of the high quality of hunts (n=46), and the abundance of animals (n=26). It was the first time hunting in the Mackenzie Mountains for 182 of 256 (71%) respondents. The 68 repeat hunters had hunted from 1-19 times previously. Of 122 respondents regarding their plans to return to the Mackenzie's to hunt in the future, 88% indicated they would like to return. Information on repeat hunts and plans to return is a minimum because we still continue to receive older forms, which should have been taken out of circulation, with this section missing. We are making every effort to ensure that only the updated voluntary hunter observation forms are provided to outfitters and their hunters.

Table 1. Province of country of origin for the 394 non-residents who purchased licences for hunting in the Mackenzie Mountains, 2005.

Canada		United States		Europe		Other	
Yukon	5	Eastern States[1]	126	Spain	3	Mexico	3
British Columbia	32			Germany	14	Philippines	0
Alberta	28	Western States[2]	165	Austria	4	Chile	4
Saskatchewan	2			Belgium	1	Argentina	1
Manitoba	0			Netherlands	0		
Ontario/ Quebec	2			Norway	1		
Atlantic Provinces	0			Switzerland	3		
Total	69		291		26		8

[1] AL, AR, CT, DE, DC, FL, GA, IL, IN, IA, KY, LA, ME, MD, MA, MI, MN, MS, MO, NH, NJ, NY, NC, OH, PA, RI, SC, TN, VT, VA, WV, WI

[2] AK, AZ, CA, CO, HI, ID, KS, MT, NE, NV, NM, ND, OK, OR, SD, TX, UT, WA, WY

Table 2. Percent of Mackenzie Mountain outfitter and non-resident hunter forms submitted, 1995-2005.

Form Type	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995
Outfitter Return (mandatory)	100	99	98	95	92	96	96	97	98	100	98
Hunter Observation (voluntary)	65	74	60	59	57	53	51	60	50	71	80

Table 3. Satisfaction ratings for non-resident hunters in the Mackenzie Mountains, 1996-2005.

Rating	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
Number of Hunters Reporting	256	229	191	193	191	158	157	202	144	224
Excellent	90%	84%	82%	82%	75%	76%	73%	80%	78%	77%
Very Good	7%	10%	15%	15%	16%	17%	20%	17%	17%	17%
Good	2%	5%	3%	3%	6%	6%	5%	2%	3%	2%
Fair	0%	0%	0%	0%	1%	0%	1%	1%	1%	3%
Poor	0%	1%	0%	0%	1%	1%	2%	0%	1%	1%

Since providing voluntary hunter observation forms we have consistently had comments about grizzly bears in the Mackenzie Mountains. Many comments have reflected a general dissatisfaction at the inability to hunt grizzly bears and about problems encountered with bears in and around camps. This year was no different (Appendices 3 and 4), however there were fewer comments than in 2004. There were also fewer hunter comments about high wolf numbers in 2005 than in 2004. Hunters did not make comments of high wolf numbers until 2000. Most reports about wolves were from zones G/OT/01, S/OT/02 and S/OT/05.

This year saw a similar number of Association of Mackenzie Mountain Outfitters meat forms voluntarily submitted to ENR by some of the outfitters (D/OT/02, S/OT/03 and S/OT/05), 95 forms in total. These forms record the amount of meat (Dall's sheep, mountain woodland caribou, moose, and mountain goat) taken from harvested animals and how the meat was utilized/distributed. The distribution of wild meat by the outfitters is often a topic of heated local debate. The provision of these meat forms allows us to better document local benefits from animals harvested by outfitting operations. ENR continues to encourage the outfitters to voluntarily provide these forms.

Generally the majority of meat from harvested Dall's sheep and mountain goats is utilized in the outfitter camps. Nonetheless, at least 306 kg (674 pounds) from 62 harvested Dall's sheep and 107 kg (235 pounds) from 6 harvested mountain goats, was distributed locally. Mountain caribou and moose meat is also utilized in the camps, however the majority of the harvested mountain caribou and moose meat was distributed locally: at least 2058 kg (4527 pounds) from 28 mountain caribou and at least 7255 kg (15 961 pounds) from 29 moose. Conservatively, the purchase of approximately 9726 kg (21 397 pounds) of meat at retail outlets in local northern communities would cost a minimum of $194 520.

Dall's Sheep (*Ovis dalli dalli*)

Dall's sheep is one of the most desired species sought by non-resident hunters in the Mackenzie Mountains. Tags to hunt Dall's sheep were purchased by 246 (62%) non-resident hunters in 2005, similar to the 10 year average (Table 4). At least 83% of sheep tag holders pursued Dall's sheep and harvested 203 rams (including 2 resident hunters). The 2005 harvest was similar to the 15 year average of sheep harvested in

Table 4. Tags for big game species purchased by non-resident hunters with outfitters in the Mackenzie Mountains, 1995-2005.

Species	2005 394 hunters		2004 337 hunters		2003 347 hunters		2002 329 hunters		2001 339 hunters		2000 332 hunters		1999 321 hunters		1998 345 hunters		1997 352 hunters		1996 387 hunters		1995 343 hunters	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Dall's Sheep	246	62	229	68	257	74	218	66	220	65	231	70	227	71	246	71	252	72	252	65	218	64
Woodland Caribou	285	72	243	72	247	71	229	69	201	59	206	62	181	56	223	65	260	74	274	71	233	68
Moose	101	26	84	25	85	24	68	21	65	19	69	21	63	20	69	20	73	21	74	18	70	20
Mountain Goat	40	10	24	7	18	5	18	5	12	4	12	4	6	2	23	7	30	8	14	4	16	5
Wolf	214	51	166	49	207	60	159	48	137	40	155	47	89	28	165	48	209	59	193	50	72	21
Wolverine	154	39	89	26	141	40	97	29	83	25	85	26	65	20	99	29	135	38	114	30	35	10
Black Bear	40	10	8	2	9	3	3	1	0	0	6	2	2	<1	2	<1	8	2	0	0	0	0

the Mackenzie Mountains (Fig. 3; Appendices 5 and 6). The average length of a sheep hunt in 2005 was 4.1 ± 2.6 days. This is generally comparable to the average lengths from 1997 to 2004 (Table 5), but considerably less than the 5.3 day average from 1979-1990 (Latour and MacLean 1994). Outfitted hunts in the Mackenzie Mountains are generally booked for 10 days; when hunters fill their sheep tag, any remaining time on the hunt is typically spent in pursuit of other big game species for which tags are held, or in hunting small game.

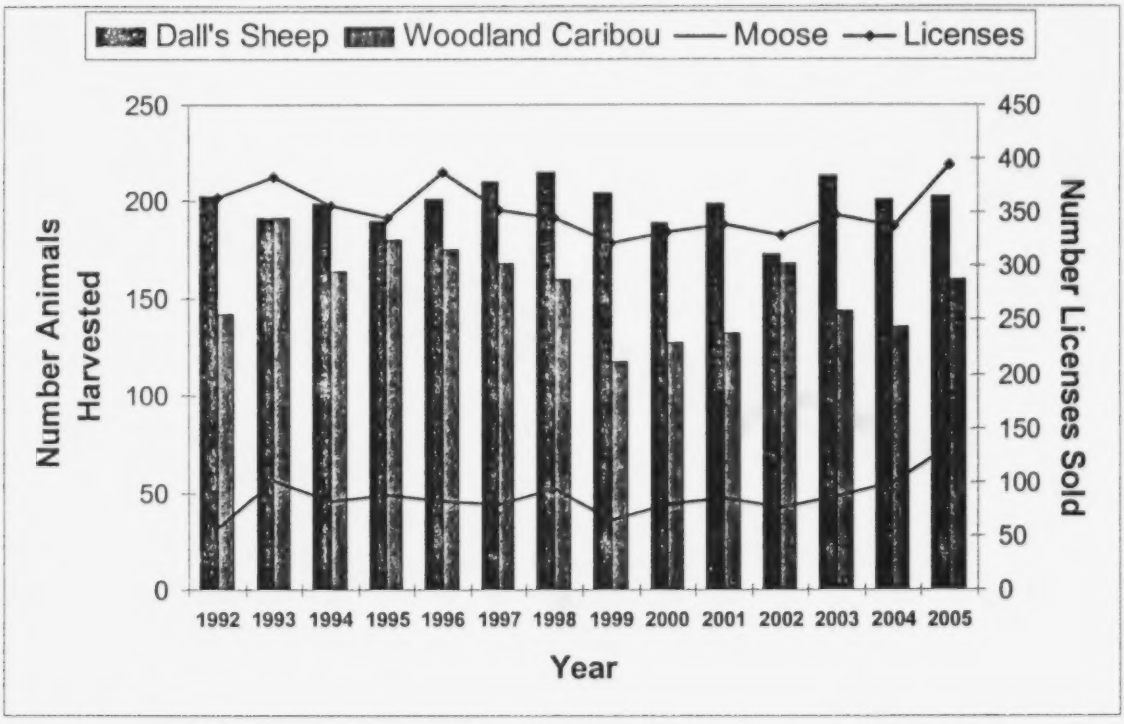

Figure 3. The number of Dall's sheep, woodland caribou, and moose harvested in the Mackenzie Mountains by non-resident hunters, and the number of non-resident licences sold during 1992-2005.

Table 5. The length of the average Dall's sheep hunt, and the range (in days) of sheep hunts where at least one day was spent hunting from 1997-2005.

	2005	2004	2003	2002	2001	2000	1999	1998	1997
Number of hunter reports	190	167	189	174	176	198	201	224	216
Average hunt length (days)	4.1±2.6	4.0±2.9	3.8±2.9	4.7±2.7	4.8±3.0	4.6±2.7	4.7±3.1	4.4±2.8	4.3±2.6
Range (days)	1-14	1-17	1-12	1-12	1-15	1-15	1-16	1-15	1-12

Harvest by non-residents comprises at least 90% of the total annual harvest of Dall's sheep in the Mackenzie Mountains and takes only 0.8 to 1.5% of the estimated 14,000 to 26,000 Dall's sheep in the Mackenzie Mountains (Veitch et al. 2000a). Therefore, the current non-resident harvest level appears well within sustainable limits, provided that hunting pressure is geographically distributed across each of the zones. In the Yukon Territory - where harvest is managed by a full curl rule - thinhorn sheep managers have set the sustainable harvest at 4% of the non-lamb population (Yukon Renewable Resources 1996). In those areas of the Yukon where the management objective is to increase population size, harvest is limited to 2% of the total population.

There has been remarkable consistency from 1979 to 2005 in the mean outside contour length of the right horns from rams harvested by non-residents (Appendix 5; Table 6), which is surprising given the increase in average age during that same period. We expected to see more broomed, or broken, horn tips on older animals, since horn breakage generally occurs as a result of fights between rival males (Geist 1993).

Table 6. Horn measurements of Dall's sheep rams harvested in the Mackenzie Mountains, 2005.

	Left Horn Contour Length		Right Horn Contour Length		Left Horn Base Circumference		Right Horn Base Circumference		Tip to Tip Spread	
	cm	in	cm	in	cm	in	cm	in	cm	in
Mean	89.09	35.07	88.70	34.92	33.8	13.3	32.8	12.9	59.3	23.3
Standard Deviation	8.48	3.34	10.76	4.24	2.02	0.80	3.05	1.2	14.47	5.7
Maximum	110.0	43.3	107.0	42.1	37.5	14.8	38.0	15.0	89.5	35.2
Minimum	49.0	19.3	49.0	19.3	25.0	9.8	27.0	10.6	45.0	17.7

In 2005, brooming was noted on 26% of left and 31% of right horns from plugged trophies. This is slightly less than the average of 31% and 32% reported over the past 10 years. One hundred and ten (54%) of 203 harvested rams were at least 10-years-old with the average age being 10.2 ± 1.9 years (range 4.5 to 14.5 years; Table 7). The 4.5 year-old sheep was accidentally shot while hunting for another legal ram. This is the eighteenth consecutive year where the reported average age of harvested rams has been 9.5 years or older (Appendix 5).

From hunters' classifications of sheep observed during their hunts in 2005 we calculated an estimated 51.3 lambs per 100 ewes. This is similar to the mean of 55 lambs per 100 ewes reported over the past 10 years (Table 8; Appendix 6). For the Richardson Mountains of the northern Yukon and NWT, Nagy and Carey (1991) suggest an August ratio of 43 lambs per 100 ewes would have allowed for their observed 10.5% average annual rate of increase from 1986 to 1991. Subsequent to a decline in this unhunted population from 1997-2003, Nagy et al. (in prep.) reported 28 lambs per 100 'nursery sheep' in August 2003. Jorgenson (1992) summarized 17 years of lamb:ewe classification data for a population of bighorn sheep in west-central Alberta and found a mean of 43 lambs per 100 ewes in September (range 25 to 54).

Table 7. Age-structure of Dall's sheep rams harvested by non-resident hunters in the Mackenzie Mountains, 1995-2005.

	2005		2004		2003		2002		2001		2000		1999		1998		1997		1996		1995	
Age	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
3.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0
4.5	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5.5	0	0.0	1	0.5	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.5	1	0.5
6.5	1	0.5	3	1.5	8	3.8	2	1.2	4	2.2	3	1.6	1	0.5	4	2.0	1	0.5	5	2.5	4	2.1
7.5	11	5.6	14	7.0	12	5.7	6	3.6	15	8.2	16	8.5	13	7.1	9	4.3	12	5.8	21	10.5	16	8.5
8.5	24	12.2	41	20.0	43	20.5	44	26.5	33	18.0	39	20.8	23	12.6	39	18.8	39	18.8	47	23.5	49	25.9
9.5	54	27.6	49	24.5	72	34.3	43	25.9	41	22.4	40	21.2	49	26.8	45	21.7	52	25.1	56	28.0	51	27.0
10.5	47	24.0	43	21.5	45	21.4	39	23.5	45	24.6	41	21.8	47	25.7	63	30.4	58	28.0	36	18.0	34	18.0
11.5	39	19.9	27	13.2	11	5.2	16	9.6	29	15.9	28	14.9	29	15.8	30	14.5	24	11.6	26	13.0	14	7.4
12.5	13	6.6	16	7.8	12	5.7	9	5.4	11	6.0	14	7.5	15	8.2	12	5.8	15	7.2	6	3.0	14	7.4
13.5	5	2.6	3	1.5	2	1.0	6	3.6	10	5.5	3	1.6	6	3.3	2	1.0	4	1.9	1	0.5	5	2.6
14.5	1	0.5	3	1.5	3	1.4	1	0.6	0	0.0	3	1.6	0	0.0	1	0.5	2	1.0	0	0.0	1	0.5
15.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
16.5	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
>10y	105		92		74		71		95		90		97		109		102		69		68	
%>10	53.6		46.0		35.2		42.7		51.0		47.9		53.0		52.6		49.5		34.5		36.0	
>12y	19		22		18		16		21		21		21		16		21		7		20	
%>12	9.7		11.0		8.6		9.6		11.2		11.2		11.4		7.7		10.1		3.5		10.6	

Table 8. Dall's sheep observations reported by non-resident hunters in the Mackenzie Mountains, 2005.

	Number of Hunters Reporting	Number Observed	Mean Number Observed/hunter	Percent of Sheep Classified
Rams	191	3686	19.3	39.3
Ewes[1]	187	3760	20.1	40.1
Lambs	173	1929	11.2	20.6

[1] includes females >1-yr-old, yearlings, and younger rams. Also called 'nursery sheep'.

Differences in adult sex ratios among populations may result from differences in hunting pressure, differences in survival of males and females from birth to adulthood, or both (Nichols and Bunnell 1999). However, since the ratio of rams to ewes is almost never equal in wild populations of mountain sheep, even where they are unhunted, it is clear that there is a different natural mortality rate for the two sexes. Geist (1971) suggested that this difference is a result of injuries and stress accumulated by males during the breeding season. The 98:100 ram to ewe ratio (ram:ewe) estimated from hunters' observations in 2005 was considerably higher than the mean of 84:100 reported during 1995-2004 (Appendix 6). In 2004 and 2005 there were more rams with <¾ curl than rams with >¾ curl observed, and the lamb:100 ewes recorded in 2002 was high in the southern Mackenzie Mountains (Larter and Allaire 2005b). Strong cohorts of juvenile rams may have been a factor in the higher ram:ewe ratio reported in 2005.

In the Yukon, mid to late June annual aerial surveys to count and classify sheep from 1973 to 1998 produced an average of 48 rams (range 28 to 74) per 100 'nursery sheep' (Jean Carey, Yukon Dept. of Renewable Resources unpublished data). For the unhunted Richardson Mountains herd (Yukon-Northwest Territories), Nagy et al. (in prep.) reported 41 rams per 100 'nursery sheep' in 2003 following a decline from peak population size in 1997. In Alaska, ram:ewe for two unhunted herds in Denali and Gates of the Arctic national parks typically averaged 60-67:100 (Nichols and Bunnell 1999). In more heavily hunted Alaskan herds, ram:ewe range from 33:100 (heavily hunted) to 87:100 (lightly hunted). Therefore, the mean ram:ewe of 83:100 calculated

from hunters' observations since 1995 (Appendix 6) suggests that the harvest of rams in the Mackenzie Mountains is sustainable at current levels.

In 2005, hunters observed similar numbers of rams (3686) to previous years (Tables 8, 9). They observed slightly fewer legal (>¾ curl) rams (n=1787) than rams with <¾ curl (n=1899) during their hunts. The mean number of legal rams observed per hunt was 9.6 (Table 9).

Mountain Woodland Caribou (*Rangifer tarandus caribou*)

Mountain woodland caribou are another of the more desired species sought by non-resident hunters. Tags were purchased by 285 (72%) non-resident hunters (Table 4), and at least 56% of tag holders hunted caribou harvesting 160 bulls. The number of bulls harvested in 2005 was similar to the mean annual harvest of 157 bulls during the past 10 years (Fig. 3; Appendix 7). The average length of a woodland caribou hunt, determined from the 191 reports where hunters spent at least 1 day hunting, was 3.67 ± 3.75 days (range 1-32 days). The average hunt length is somewhat less than for hunts in 2004, but similar to hunts during the previous 4 years (Table 10).

In 2005 we had the greatest percentage of reported antler lengths (82%; n=131) from harvested caribou. Similar to in previous years there was substantial variation in antler lengths, range 81.3-142.2 cm and a mean of *ca.* 115.1±30.5 cm. The maximum left and right antler lengths reported were 142.2 and 140.0 cm respectively (Table 11). The maximum antler length recorded by Boone and Crockett for mountain caribou in North America is 158.5 cm (62.4 in) for a caribou taken from the Mackenzie Mountains in 1978 (Byers and Bettas 1999). Thirteen of the top 50 mountain caribou recorded in the 11th edition of the Boone and Crockett Club record book are from the Mackenzie Mountains, with the highest scoring antlers holding 6th place (Byers and Bettas 1999).

Table 9. Classification of Dall's sheep rams observed by non-resident hunters in the Mackenzie Mountains, 1995 - 2005.

	2005		2004		2003		2002		2001		2000	
Ram Class	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl
Number of hunters Reporting	186	182	188	183	127	121	148	133	186	174	151	147
Number of rams Classified	1787	1899	2185	2324	1662	1654	1720	1720	1812	1765	1351	1717
Percent of rams classified	48.5	51.5	48.5	51.5	50.1	49.9	50.0	50.0	50.7	49.3	44.0	56.0
Mean number of rams observed/hunt	9.6	10.4	11.6	12.7	11.9	11.9	11.6	12.9	9.7	10.1	8.9	11.7

	1999		1998		1997		1996		1995	
Ram Class	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl
Number of hunters Reporting	144	138	177	177	205	205	172	174	181	180
Number of rams Classified	1579	1756	1848	1924	1538	1586	1713	1699	2070	1645
Percent of rams classified	47.3	52.7	49.0	51.0	49.2	50.8	50.2	49.8	55.7	44.3
Mean number of rams observed/hunt	11.0	12.7	10.4	11.3	7.5	7.7	10.0	9.8	11.4	9.1

Table 10. The length of the average caribou hunt, and the range (in days) of caribou hunts where at least one day was spent hunting from 2000-2005.

	2005	2004	2003	2002	2001	2000
Number hunter reports	191	120	172	181	178	141
Average hunt length (days)	3.7±3.8	4.9±3.9	3.8±2.8	3.6±2.7	4.3±3.2	4.0±2.7
Range (days)	1-32	1-34	1-14	1-12	1-15	1-12

Table 11. Antler measurements of mountain woodland caribou bulls harvested by non-resident hunters in the Mackenzie Mountains, 2005.

	Contour Length	
	Left Antler	Right Antler
Number Measured	131	131
Mean (cm)	114.8	115.4
Mean (in)	45.2	45.4
Standard Deviation	30.6	30.4
Standard Deviation	12.0	12.0
Maximum (cm)	142.2	140.0
Maximum (in)	56.0	55.1
Minimum (cm)	81.3	83.8
Minimum (in)	32.0	33.0

From hunters' classifications of woodland caribou observed during their hunts, we calculated ratios of 42.4 calves and 41.6 bulls per 100 adult females (cows); bulls comprised 22.6% of all caribou classified (Table 12). The ratios of both calves and bulls:100 cows is similar to the averages reported over the past 10 years, of 43 calves and 36 bulls per 100 adult females (Appendix 6). As in 3 of the past 4 years

Table 12. Mountain woodland caribou observations reported by non-resident hunters in the Mackenzie Mountains, 2005.

Sex/Age Class	Number of Hunters Reporting	Number Observed	Mean Number Observed/hunter	Percent of Total Classified
Bulls	203	4157	20.5	22.6
Cows	193	9983	51.7	54.3
Calves	169	4230	25.0	23.1

bulls have comprised *ca.* 22% of the observed caribou; bulls comprised 27%. This is a consistently lower percentage than the cumulative 39% average adult bull component reported by Bergerud (1978) in his summary of 8 North American caribou populations that were either non-hunted or hunted non-selectively (i.e., both males and females included in the harvest). Veitch et al. (2000c) classified 2659 of an estimated 5000 caribou in the central Mackenzie Mountains in August 1999 and reported only 25% of those animals were classified as males. Surveys made on the rutting grounds of the South Nahanni caribou herd provided in 1995, 1996, and 1997 reported 24, 28, and 20% of animals classified as males ≥1-year-old (Gullickson and Manseau 2000) and in 2001 reported 27% bulls (Gunn et al. 2002). Therefore, further investigation is warranted to determine the reason for the consistently lower bull:cow ratios reported for caribou in the Mackenzie Mountains. Caribou in the Mackenzie Mountains are estimated to number between 13 000 and 18 000 from at least 3 separate herds shared between the Yukon and Northwest Territories: Bonnet Plume herd (5000 estimated), the greater Redstone herd (5-10 000 estimated), and the greater Nahanni herd (2-3000 estimated) (Yukon Renewable Resources 1996; J. Adamczewski personal communication; M. O'Donoghue personal communication). They are subjected to an annual bull-selective non-resident harvest averaging only 156 animals per year (1991-2004). The resident harvest of woodland caribou in the Mackenzie Mountains also tends to be bull-selective (but not restricted to bulls) and is generally

light (i.e., 30 animals/year); subsistence harvest includes both males and females, with the proportion of each dependent on the time of year that animals are harvested (J. Snortland unpublished data; K. Davidge personal communication).

Studies on mountain caribou have recently been initiated. In March 2002, 10 female caribou from the Redstone caribou herd were equipped with satellite radio collars as part of a study of caribou in the central and north-central Mackenzie Mountains initiated by the Sahtu Renewable Resources Board (Olsen 2000; 2001; Olsen et al. 2001). In October 2004, 18 female caribou were equipped with satellite collars along the Yukon-Northwest Territories border. These caribou were believed to be from the greater Nahanni herds. This is a co-operative study between the Yukon Territorial Government, Parks Canada (Nahanni National Park) and the Wildlife Conservation Society.

Alaska-Yukon Moose (*Alces alces gigas*)

Moose in the Mackenzie Mountains belong to the Alaska-Yukon subspecies of moose (also known as tundra moose) that occur across Alaska, the Yukon, extreme northern British Columbia, and the Mackenzie Mountains, with the Mackenzie's representing the eastern limit of the subspecies' range. This is the largest of the four subspecies of moose that occur in North America (Bubenik 1997). Tags to hunt moose were purchased by 26% of non-resident hunters in 2005, the highest percentage recorded (Table 4). At least 73% of tag holders hunted moose and harvested 74 bulls. The number of moose harvested in 2005 was considerably higher than in previous years being greater than the average annual moose harvest of 46 from 1991-2004 (Fig. 3; Appendix 7). The average length of a moose hunt, determined from the 85 reports where hunters spent at least 1 day hunting, was 4.4 $\pm$ 3.1 days (range 1-14 days), not noticeably different from that reported in previous years (Table 13).

Table 13. The length of the average moose hunt, and the range (in days) of moose hunts where at least one day was spent hunting from 2000-2005.

	2005	2004	2003	2002	2001	2000
Number hunter reports	85	49	60	46	42	48
Average hunt length (days)	4.4±3.1	4.8±3.3	3.9±2.8	3.6±2.6	3.7±2.9	4.4±2.7
Range (days)	1-14	1-12	1-14	1-12	1-12	1-12

The mean tip-to-tip spread of measured antlers from bull moose harvested by non-residents in 2005 was 146.5 ± 24.9 cm (57.7 ± 9.8 in., n=53). This is similar to that recorded for previous years (Table 14). However, this year's maximum recorded antler spread was 218.4 cm (86.0 in.), 30.4 cm (12 in.) wider than the maximum recorded antler spread (188.0 cm; 74 in.) for an Alaska-Yukon moose taken in the NWT in 1995. Two moose taken from the Mackenzie Mountains are in the top 20 Alaska-Yukon moose recorded in the record book of the Boone and Crockett Club and hold places 11 and 15 (Byers and Bettas 1999); the rest of the top 20 were all taken in Alaska. The maximum antler spread recorded from across the subspecies' range is 218.4 cm (86.0 in) from a moose taken this year.

Table 14. The yearly mean and range in measured bull moose tip-to-tip antler spread (cm).

	2005	2004	2003	2002	2001	2000	1999
Measured (n)	53	38	34	32	32	34	26
Average spread	146.5	150.3	150.0	149.3	144.3	147.0	144.2
Range	122-218	127-174	107-165	103-178	113-165	127-179	109-166

From hunters' observations of moose seen during hunts we calculated ratios of 32.5 calves:100 adult females (cows) and 110.2 bulls:100 cows (Table 15). This is the

first time in the past 11 years in which the moose calf:cow ratio has been greater than 30:100. The ratio still remains lower than the 40-60:100 that is generally documented during early to mid-winter aerial surveys for northwestern moose (*Alces alces andersoni*) along the Mackenzie River in the vicinity of the communities of Fort Good Hope (MacLean 1994a), Norman Wells (Veitch et al. 1996), and Tulita (MacLean 1994b) (Appendix 6). However, these surveys are conducted after the major fall subsistence harvest and variable female harvest can certainly impact the interpretation of cow:calf ratios. No research has been done on moose in the Mackenzie Mountains; therefore, we have no explanation for the apparent discrepancy in calf production, survival, or both between the mountains and the river valley. A survey of moose in the Norman Wells study area in January 2001 estimated a calf:cow ratio of 18:100 (ENR, Norman Wells unpublished data), and an aerial survey of the Mackenzie River Valley and vicinity in the Dehcho Region south from the Blackwater River to Jean Marie River conducted in November 2003 estimated 32:100 (N. Larter unpublished data), indicating that low calf:cow ratios may not be restricted to the Mackenzie Mountains and that more study is required to determine the cause(s). A program has recently been established in the Mackenzie and Liard River Valleys of the Dehcho to document calf:cow ratios annually in November (ENR, Fort Simpson unpublished data).

Table 15. Moose observations reported by non-resident hunters in the Mackenzie Mountains, 2005.

Age/Sex class	Number of Hunters Reporting	Number Observed	Mean Number Observed/Hunter	Percent of Total Classified
Bulls	125	508	4.06	45.4
Cows	114	461	4.04	41.2
Calves	71	150	2.11	13.4

The bull:cow ratio of 110:100 was higher than the average reported from 1995-2005 (101:100, range 76-129:100; Appendix 6). Bull:cow ratios from the Mackenzie

Mountains continue to be generally higher than the range of 27-105:100 reported in the Yukon (R. Ward cited in Schwartz 1997) and from heavily harvested populations in Alaska of 16:100 (Schwartz et al. 1992) and Norway of average 46:100, range (25-69:100) (Solberg et al. 2002). There has been concern that low bull:cow ratios could influence conception dates, pregnancy rates and newborn sex ratios (Bishop and Rausch 1974; Crête et al. 1981; Solberg et al. 2002) and that management strategies should maintain a high bull:cow ratio (Bubenik 1972). Studies on tundra moose in Alaska have not found evidence that moose populations with low bull:cow ratios have reduced reproductive rates (Schwartz et al 1992); populations with a more skewed sex ratio had a relative rate of population increase greater than populations without a skewed sex ratio (Van Ballenberghe 1983). However, a recent study of 8 heavily harvested moose populations in Norway indicated a relationship between declining recruitment rate and skewed adult sex ratio (Solberg et al. 2002). Based upon hunter observations since 1995, there is no indication of any decreasing trend in the bull:cow ratio of moose in the Mackenzie Mountains hence the adult sex ratios are not a factor in the low calf:cow ratios reported. The reported sex ratios may have an inherent bias towards a greater number of bulls if harvesters consistently spend more time searching for moose in areas frequented more by large males than females.

Mountain Goat (*Oreamnos americanus*)

Sales of mountain goat tags show more annual fluctuation than for any other ungulate species harvested by non-resident hunters in the Mackenzie Mountains, range 6-38 (1991-2004; Table 4) with an average annual harvest of 4 goats (range 1-9) over the same time (Appendix 7). In 2005, mountain goat tags were purchased by 40 (10%) non-resident hunters, and a total of 18 goats were harvested; 16 billies and 2 nannies (Table 4). Although the number of tags sold was slightly higher than that reported for a few years in the early 1990s there were far more successful goat hunters in 2005. The average length of a goat hunt, determined from the 18 reports where hunters spent at least 1 day hunting, was 3.8 $\pm$ 2.8 days (range 1-14 days). The average hunt length was similar to that in 2004, and higher than in the previous 4 years (Table 16).

Table 16. The length of the average goat hunt, and the range (in days) of goat hunts where at least one day was spent hunting from 2000-2005.

	2005	2004	2003	2002	2001	2000
Number hunter reports	18	8	6	4	2	1
Average hunt length (days)	3.8±2.8	3.9±1.6	3.0±2.6	2.8±1.9	1.5±0.7	3.0
Range (days)	1-14	2-6	1-8	1-5	1-2	3

Mountain goats are known to occur in 5 of the 8 outfitting zones in the Mackenzie Mountains, occurring almost exclusively below 63° 00' N (Veitch et al. 2002). They are most numerous in high relief terrain along the Yukon-Northwest Territories border between 61° 00' and 62° 00' N. However, since 1995 we have received hunter observations or harvest reports of goats from only 4 of those outfitter zones - D/OT/01, D/OT/02, S/OT/03, and S/OT/04 (see Fig. 1). In 2005, observations of mountain goats by hunters came from just 2 of those zones D/OT/01 (n=14), and D/OT/02 (n=16), even though mountain goats were harvested in 3 zones including S/OT/03. We estimated 66.0 kids and 50.4 billies per 100 nannies based upon this year's hunter observations.

There is some evidence that goat numbers and distribution have been increasing in zone D/OT/02 in the southern Mackenzie Mountains (Larter 2004; Cam and Clay Lancaster personal communication). In 2005, there were more goats observed and both the ratio of kids and billies per 100 nannies were higher in zone D/OT/02 than D/OT/01. The 73.9 kids and 108.7 billies per 100 nannies reported in zone D/OT/02 in 2005 is similar to that reported from an aerial survey of part of the same zone conducted in September 2004 (71.4 kids and 111 billies per 100 nannies; Larter 2004). These data would support the contention of increasing goat numbers.

The largest horns from a mountain goat taken in 2005 were 24.1 cm (right) and 24.2 cm (left). No mountain goats from the NWT are listed in the 11th edition of the Boone and Crockett Club record book (Byers and Bettas 1999).

Wolf (*Canis lupus*)

Wolf tags were purchased by 51% of non-resident hunters in 2005 (Table 4) with 19 wolves harvested (Appendix 7). This is 1 more wolf than was harvested in 2004 and more than the average of 13 wolves taken annually from 1991-2004. In 2005, more hunters observed at least one wolf than in most previous years. The number of wolves observed in 2005 (n=245) was substantially higher than in the previous 10 years (Table 17). Even though more wolves were observed in 2005 only 1% of responding hunters indicated that they believed wolf numbers were high; down from the 8 and 12% respectively for 2000 and 2002. 2000 was the first year that hunters had commented on wolf numbers in the wildlife observation forms.

The number of hunters reporting since 2001 has been consistently higher than in previous years. This we attribute to a change in how we defined hunter reporting. For data collected after 2001, we assumed that all returned observation forms where there was a blank, a zero, or a dash in the box indicating the number of wolves observed was a report of no wolves being observed. When looking at the forms this seemed like a reasonable assumption. This assumption may well be invalid for previous years' data and would bias the post 2001 values to be higher than the previous years.

Table 17. Wolf observations reported by non-resident hunters in the Mackenzie Mountains, 1995-2005.

	2005[1]	2004[1]	2003[1]	2002[1]	2001	2000	1999	1998	1997	1996	1995
Number hunters reporting	254	215	203	197	142	116	103	148	141	76	119
Number wolves observed	245	317	200	249	215	228	142	148	200	186	269
Mean observed/hunter	1.0	1.5	1.0	1.3	1.5	2.0	1.4	1.0	1.4	2.4	2.3
Number hunters seeing ≥1	76	81	74	69	65	61	40	57	76	26	26

[1] Change in reporting since 2002 may have resulted in the number of hunters reporting for 1995-2001 being artificially low, see text.

Wolverine (*Gulo gulo*)

Wolverine tags were purchased by 39% (n=154) of non-resident hunters (Table 4). At least 27% (n=42) of tag holders actively hunted wolverines, but only 1 was harvested in 2005. Hunters reported spending from 1-12 days actively hunting wolverine (average 6.0±3.0 days). A total of 28 wolverines were reported observed by hunters this year, with observations being reported from all of the outfitter zones (Fig. 4). The number of animals observed this year has returned to levels reported from 1996-1999 and 2004, but is substantially greater than that observed from 2000-2003 (Table 18; Fig. 4).

Table 18. The number of reported observations of wolverine, the number of wolverine harvested, the number of hunters with wolverine tags, the percentage of total hunters with wolverine tags, and the total number of hunting tags purchased for 1995-2005.

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Reported Observed	21	34	36	34	30	11	9	9	12	30	28
Number Harvested	1	4	1	0	3	0	2	1	0	0	1
No. Wolverine Tags	35	114	135	99	65	78	83	97	141	89	154
% Wolverine Tags	11	29	38	29	20	23	26	29	40	26	39
Total Hunting Tags	333	387	352	345	321	332	344	338	347	337	394

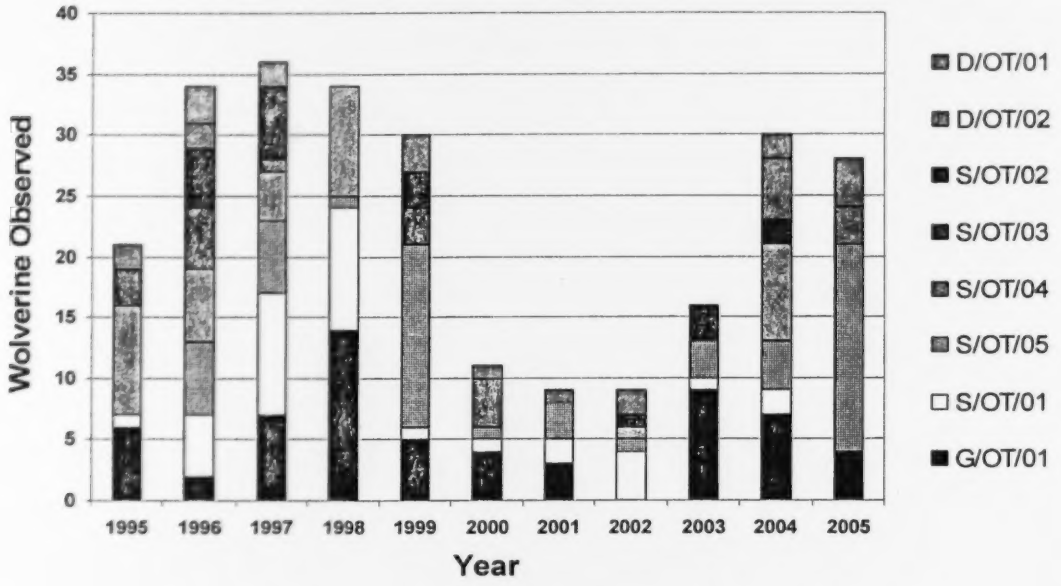

Figure 4. The number of wolverines observed by hunters from 1995-2005, and the outfitter zones where the observations occurred. Data are based upon voluntary hunter observation forms.

Historically, observed wolverines have been solitary animals with few family groups being observed. This year all observations were of single wolverines. One hunter commented that a wolverine stole some goat meat. There are no relationships between the number of wolverines observed/year and annual harvest or tags purchased/year that explain the differences in the number of wolverines observed (Table 18). Wolverines occur throughout the Mackenzie Mountains, but sightings are considered rare. Most wolverine observations are made in hunting zones G/OT/01, S/OT/01, S/OT/04, and S/OT/05, as was the case this year over half of the observations were from S/OT/05.

Black Bear (*Ursus americanus*)

Although non-resident hunters purchased 40 black bear tags in 2005, none were harvested as was the case in the previous 10 years. Black bears are relatively rarely seen in the Mackenzie Mountains and in most years are reported only from south of 63° 00 N. In 2005, a total of 25 black bears (21 adults and 4 cubs) were observed based upon returned (n=256) voluntary observation forms. Bears were observed in outfitter zones D/OT/01 (4 adults), D/OT/02 (12 adults and 1 cub), G/OT/01 (1 adult), S/OT/01 (2 adults) and S/OT/05 (2 adults and 3 cubs) (Table 19). As with the other post 2001 carnivore data, we assumed that all returned observation forms where blanks, zeroes, or dashes occurred in the boxes indicating the number of carnivores observed was a report of no carnivores being observed. This assumption is likely invalid for previous years' data and likely inflates the 2002 through 2005 values relative to 1996-2001 values.

Grizzly Bear (*Ursus arctos*)

The Mackenzie Mountains have been closed to non-residents for hunting grizzly bears since 1982 and resident hunters have been restricted to one bear per lifetime since the same year (Veitch 1999). It is clear from the comments made by hunters on voluntary observation forms that, despite the lack of hunting opportunities, grizzly bears remain a subject of considerable interest for non-resident hunters and their guides in the Mackenzie Mountains (Appendices 3 and 4). Consistent with the past 7 years, this

year hunters reported loss of meat, capes, food, and equipment to grizzly bears, a perception that there were too many grizzly bears, and several implicated grizzly bears as the principal reason for low numbers of moose and caribou calves. Moose calf numbers, based upon hunter observations, are generally lower in the Mackenzie Mountains than those reported in the Mackenzie valley and predation by grizzly bears could be a potential cause as has been demonstrated elsewhere (Ballard 1992). However, hunter observations of caribou calves would tend to refute grizzly bear predation as major impact on caribou calf numbers. A frequent comment of guided hunters is that bears have lost their fear of humans because of a lack of hunting and a concern that this was a human safety issue. There have been no documented injuries from grizzly bear attacks in the Mackenzie Mountains since the closure of the non-resident grizzly bear hunting season (Veitch 1999). However, at least 1 nuisance grizzly bear has been killed annually since 1993, with a total of 44 nuisance grizzly bear kills; 42 in the Sahtu and 2 in the Dehcho (ENR Norman Wells and Fort Simpson unpublished data).

While the mean number of adult grizzly bears observed by hunters has remained relatively stable from 1996-2005 (mean=311), the cub to adult ratio calculated from the hunter observations peaked in 2000 with cubs comprising 29% of all bears observed, and has declined since. The 2005 observations indicate a continued upswing in the proportion of cubs observed from a 2003 low of 12% (Fig. 5; Table 20). Because cub grizzlies in the Mackenzie Mountains tend to stay with their mothers for 3 years (Miller et al. 1982), reported observations of 'cubs' refers to cubs-of-the-year, yearlings, and 2-year-old bears. Miller et al. (1982) documented a low reproductive rate for female grizzly bears in Mackenzie Mountains, with no sows less than 8-years-old producing cubs, an average inter-litter interval of 3.8 years, and a mean litter size of 1.8. The percent 'cubs' determined from reported hunter observations during 1996-2005 continues to indicate an inter-litter interval of 4 years (Fig. 5), similar to what was reported during 1973-1977 when there was non-resident hunting of grizzly bears. We estimated the mean litter size from 1996-2005 hunter observation reports by analyzing

Table 19. Black bear observations reported by non-resident hunters in the Mackenzie Mountains, 1995-2005.

	2005[1]		2004[1]		2003[1]		2002[1]	
	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult
Total # Observed	4	21	1	23	3	34	3	17
% of Total Observed	16	84	4	96	8	92	15	85
No. Hunters Reporting	256	256	229	229	191	191	199	199
No. Hunters Saw at Least 1	3	18	1	19	2	21	2	14
Maximum # Observed	2	2	1	3	2	7	2	3

[1] Change in reporting for 2002 may have resulted in artificially lower numbers of hunters reporting for 1995-2001, see text.

[2] All bears not separated out by cubs and adults.

	2001		2000		1999		1998		1997		1996		1995[2]
	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	All Bears
Total # Observed	0	7	2	15	4	7	0	15	2	3	1	10	11
% of Total Observed	0	100	12	88	36	64	0	100	40	60	9	99	nil
No. Hunters Reporting	127	130	88	93	87	89	121	124	96	96	6	14	44
No. Hunters Saw at Least 1	1	7	1	10	2	6	0	8	2	3	1	9	9
Maximum # Observed	0	1	2	3	2	2	0	3	1	1	1	2	2

just those observations of groups of grizzly bears where cubs were present with only 1 adult present. The estimated mean litter size was 2.0 (range 1.4-2.0) which is the greatest we have recorded from 1996-2005. The 2005 litter size is between that found by Miller et al. (1982) and the 2.2 reported for grizzly bears of Kodiak Island, Alaska (Troyer and Hensel 1964). Other than possibly the 2005 litter size estimate, there appears to have been little change in demographic parameters of Mackenzie Mountain grizzly bears estimated during 1996-2005 compared to those reported during 1973-1977 by Miller at al. (1982).

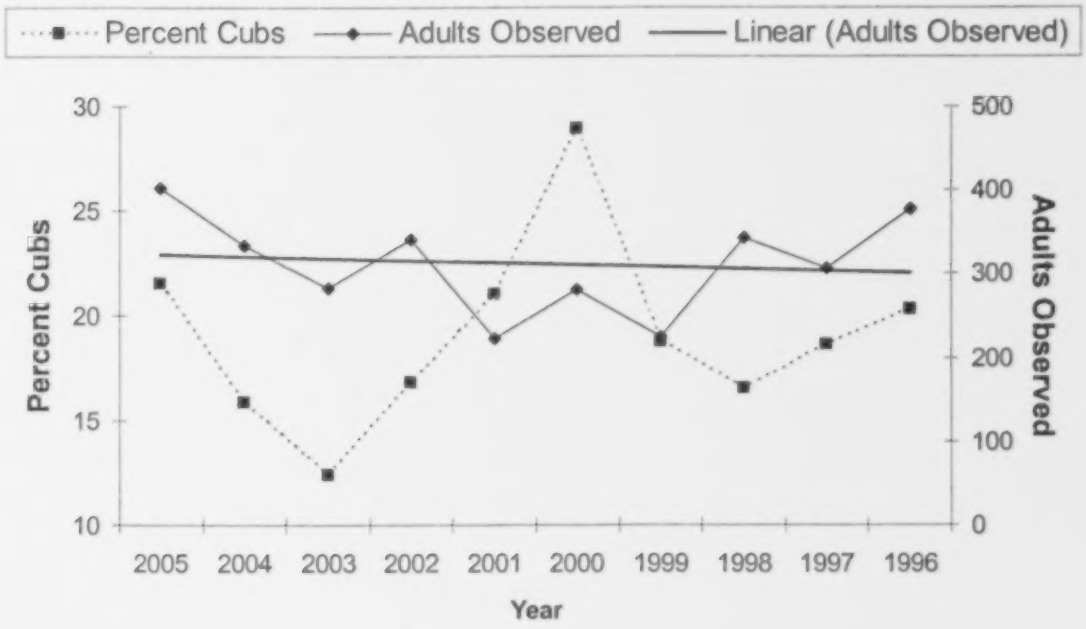

Figure 5. The percent of 'cubs' and the total number of adult grizzly bears observed by hunters from 1996-2005. Data are based upon voluntary hunter observation forms. The linear trend of total adult bears observed during the same time period is indicated

Table 20. Grizzly bear observations reported by non-resident hunters in the Mackenzie Mountains, 1995-2005; total number of bears observed, percent of cubs/adults, number of hunters reporting grizzly observations, number of hunters seeing at least one cub/adult, the mean and maximum number of cub/adults observed. [1] All bears were not separated out by cubs and adults.

	2006		2005		2004		2003		2002		2001	
	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult
Total # Observed			110	402	63	333	40	283	69	341	59	222
% of Total #			21	79	16	84	12	88	17	83	21	79
# Hunters reporting			49	150	34	131	19	120	34	128	136	171
# Hunters saw ≥1			10	65	15	57	9	53	11	48	28	104
Mean # Observed			2.0	2.3	1.9	2.5	2.1	2.4	2	2.7	0.4	1.3
Max. # Observed			10	16	4	15	12	7	8	20	5	10

	2000		1999		1998		1997		1996		1995
	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	Cub	Adult	All Bears[1]
Total # Observed	113	281	52	225	68	343	70	306	96	377	389
% of Total #	29	71	19	81	17	83	19	81	20	80	nil
# Hunters reporting	108	131	98	117	139	177	110	170	49	132	138
# Hunters saw ≥1	51	97	28	81	31	105	32	129	46	129	123
Mean # Observed	1.1	2.1	0.5	1.9	0.5	1.9	0.6	1.8	2.0	2.9	2.8
Max. # Observed	8	12	4	12	6	16	12	17	5	15	16

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Co-operation from the outfitters operating in the Mackenzie Mountains in 2005 was again very good and we thank them for the extra efforts they made in completing, signing, and sending us their harvest report and meat distribution forms. We thank Renewable Resources Officers and clerks with ENR in Norman Wells, Fort Simpson, and Fort Liard for collecting and organizing data from non-resident hunters in their respective offices.

We also greatly appreciate the efforts, interest, and co-operation shown by our visiting hunters and the more than 80 guides that completed the forms, reported observations of animals seen, and did the various antler and horn measurements. In addition, we would like to particularly thank those hunters that took the time to write comments about their hunting experience.

We thank Keith Hickling for ensuring that all data received by the Sahtu ENR office was forwarded to the Fort Simpson ENR office, and for providing the nuisance bear data. John Nagy provided unpublished data from his Dall's sheep work in the Richardson Mountains.

PERSONAL COMMUNICATIONS

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Ken Davidge, Renewable Resources Officer, Department of Environment and Natural Resources, Ft. Simpson, NT.

Cam and Clay Lancaster, Nahanni Butte Outfitters, Hudson Hope, BC

Mark O'Donoghue, Northern Tutchone Regional Biologist, Fish and Wildlife Branch, Yukon Environment, Mayo, YT.

LITERATURE CITED

Ballard, W.B. 1992. Bear predation on moose: A review of recent North American studies and their management implications. Alces (Suppl.) 1: 1-15.

Bergerud. A.T. 1978. Caribou. pp. 83-102 *in* Schmidt, J.L. and Gilbert, D.L. (eds.) Big game of North America: ecology and management. Stackpole Books, Harrisburg, PA. 494 pp.

Bishop, R.H. and Raush, R.A. 1974. Moose population fluctuations in Alaska. 1950-1972. Naturaliste Canadien 101: 559-593.

Bubenik, A.B. 1972. North American moose management in light of European experiences. Proceedings of the North American Moose Conference Workshop 8: 279-295.

Bubenik, A.B. 1997. Evolution, taxonomy, and morphophysiology. pp. 77-123 *in* Franzmann, A.W. and Schwartz, C.C. (eds.) Ecology and management of the North American moose. Smithsonian Institution Press, Washington, DC. 733 pp.

Byers, C.R. and Bettas, G.A. 1999. Records of North American Big Game. 11th Edition. Boone and Crockett Club, Missoula, MT. 712 pp.

Crête, M., Taylor, R.J., and Jordan, P.J. 1981. Optimization of moose harvest in southwestern Quebec. Journal of Wildlife Management 45: 598-611.

Department of Environment and Natural Resources, 2005. Northwest Territories summary of hunting regulations 2005-2006. Department of Environment and Natural Resources, Yellowknife, NT. 26 pp.

EXCELeration corp. 2000. Benefits of outfitted hunting in the NWT Mackenzie Mountains. Final report prepared for the Association of Mackenzie Mountain Outfitters in co-operation with the town of Norman Wells and the Department of Resources, Wildlife & Economic Development. Calgary, AB. 45 pp.

Geist, V. 1971. Mountain sheep: a study in behaviour and evolution. University of Chicago Press, Chicago, IL. 383 pp.

Geist, V. 1993. Wild sheep country. NorthWord Press, Minocqua, WI. 173 pp.

Gullickson, D. and Manseau, M. 2000. South Nahani woodland caribou herd seasonal range use and demography. Parks Canada Agency. 79pp.

Gunn, A., Farnell, R., Adamczewski, J., Dragon, J. And Labarge, L. 2002. Census for the South Nahanni mountain caribou herd, September 2001. Manuscript Rep. No. 147, Dept. of Resources, Wildlife & Economic Development, Yellowknife, NT. 31pp.

Jorgenson, J.T. 1992. Seasonal changes in lamb:ewe ratios. Northern Wild Sheep and Goat Council 8: 219-226.

Larter, N.C. 2004. Mountain goat survey Flat River area, Western Mackenzie Mountains, September 2004. Manuscript Rep. No. 157, Dept. of Resources, Wildlife & Economic Development, Ft. Simpson, NT. 16pp.

Larter, N.C. and Allaire, D.G. 2003. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary 2002. Manuscript Rep. No. 152, Dept. of Resources, Wildlife & Economic Development, Ft. Simpson, NT. 46pp.

Larter, N.C. and Allaire, D.G. 2004. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary 2003. Manuscript Rep. No. 154, Dept. of Resources, Wildlife & Economic Development, Ft. Simpson, NT. 46pp.

Larter, N.C. and Allaire, D.G. 2005a. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary 2004. Manuscript Rep. No. 165, Dept. of Environment and Natural Resources, Ft. Simpson, NT. 46pp.

Larter, N.C. and Allaire, D.G. 2005b. Sheep surveys of the Liard Range, Nahanni Range, and Ram Plateau in the Mackenzie Mountains, August 2003. Manuscript Rep. No. 166, Dept. Environment and Natural Resources, Ft. Simpson, NT. 16pp.

Latour, P. and MacLean, N. 1994. An analysis of data returned by outfitted hunters from the Mackenzie Mountains, NWT, 1979-1990. File Rep. No 110, Dept. of Renewable Resources, Norman Wells, NT. 41 pp.

MacLean, N. 1994*a*. Population size and composition of moose in the Tulita area, NWT, November 1993. Manuscript Rep. No. 78, Dept. of Renewable Resources, Yellowknife, NT. 18 pp.

MacLean, N. 1994*b*. Population size and composition of moose in the Fort Norman area, NWT, November 1993. Manuscript Rep. No. 80, Dept. of Renewable Resources, Yellowknife, NT. 17 pp.

Miller, S.J., Barichello, N. and Tait, D. 1982. The grizzly bears of the Mackenzie Mountains, Northwest Territories. N.W.T. Wildl. Serv. Compl. Rep. No. 3, Yellowknife, NT. 118 pp.

Minitab Inc. 1989. Minitab version 7.2 (computer program). State College, PA : Minitab Inc.

Nagy, J. and Carey, J. 1991. Dall sheep survey in the Richardson Mountains, 1991. Unpublished survey report manuscript, Dept. of Resources, Wildlife, and Economic Development, Inuvik, NT. 8 pp.

Nagy, J.A., Auriat, D. and Cooley, D. in prep. Richardson Mountains Dall's Sheep population survey, August 2003.

Nichols, L. and Bunnell, F. 1999. Natural history of thinhorn sheep. pp. 23-77 *in* Valdez, R. and Krausman, P.R. (eds.). Mountain sheep of North America. University of Arizona Press, Tucson, AZ. 353 pp.

Olsen, B. 2000. Fall distribution and population composition of woodland caribou in the central Mackenzie Mountains, October 2000. Manuscript Report No. 1 (draft), Sahtu Renewable Resources Board, Tulita, NT. 15 pp.

Olsen, B. 2001. Caribou studies in the Redstone River watershed: research proposal 2001. Unpublished research proposal submitted to Sahtu Renewable Resources Board, Tulita, NT. 5 pp.

Olsen, B., MacDonald, M., and Zimmer, A. 2001. Co-management of woodland caribou in the Sahtu Settlement Area: Workshop on Research, Traditional Knowledge, Conservation and Cumulative Impacts. Special Publication No. 1, Sahtu Renewable Resources Board, Tulita, NT. 22 pp.

Schwartz, C.C. 1997. Reproduction, natality, and growth. pp. 141-171 *in* Franzmann, A.W. and Schwartz, C.C. (eds.) Ecology and management of the North American moose. Smithsonian Institution Press, Washington, DC. 733 pp.

Schwartz, C.C., Regelin, W.L., and Franzmann, A.W. 1992. Male moose successfully breed as yearlings. Journal of Mammalogy 63: 334-335.

Simmons, N.M. 1968. Big game in the Mackenzie Mountains, Northwest Territories. Proceedings of the Federal-Provincial Wildlife Conference. 32: 35-42.

Solberg, E.J., Loison, A., Ringsby, T.H., Sæther, B.E., and Heim, M. 2002. Biased adult sex ratio can affect fecundity in primiparous moose *Alces alces*. Wildlife Biology 8: 117-128.

Troyer, W.A., and Hensel, R.J. 1964. Structure and distribution of a Kodiak bear population. Journal of Wildlife Management 28: 769-772.

Van Ballenberghe, V. 1983. The rate of increase in moose populations. Alces 25: 25-30.

Veitch, A.M. 1999. Status of grizzly bears in the Mackenzie Mountains, NWT. Unpublished report, Department of Resources, Wildlife & Economic Development, Norman Wells, NT. 28 pp.

Veitch, A.M. and Popko, R.A. 1996. 1995 Mackenzie Mountain non-resident hunter harvest summary. Manuscript Rep. No. 90, Dept. of Renewable Resources, Norman Wells, NT.
22 pp.

Veitch, A.M. and Popko, R.A. 1997. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary, 1996. Manuscript Report No. 97, Dept. of Resources, Wildlife & Economic Development, Norman Wells, NT. 37 pp.

Veitch, A.M., Popko, R.A., and N. McDonald. 1996. Size, composition, and harvest of the Norman Wells area moose population, November 1995. Manuscript Rep. No. 93, Dept. of Renewable Resources, Norman Wells, NT. 32 pp.

Veitch, A.M. and Simmons, E.N. 1998. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary, 1997. Manuscript Report No. 106, Dept. of Resources, Wildlife & Economic Development, Norman Wells, NT. 28 pp.

Veitch, A.M. and Simmons, N. 1999. Dall's sheep – Northwest Territories. pp. 54-58 *in* Toweill, D.E. and Geist, V. (eds.) Return of royalty: wild sheep of North America. Boone and Crockett Club and Foundation for North American Wild Sheep, Missoula, MT. 214 pp.

Veitch, A. and Simmons, E. 2000a. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary, 1999. Manuscript Report No. 121, Dept. of Resources, Wildlife & Economic Development, Norman Wells, NT. 29 pp.

Veitch, A. and Simmons, E. 2000b. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary, 2000. Manuscript Report No. 121, Dept. of Resources, Wildlife & Economic Development, Norman Wells, NT. 40 pp.

Veitch, A.M., Simmons, E., Adamczewski, J., and Popko, R. 2000a. Status, harvest, and co-management of Dall's sheep in the Mackenzie Mountains, NWT. Northern Wild Sheep and Goat Council 11: 134-153.

Veitch, A., Simmons E., and Whiteman, N. 2000b. Mackenzie Mountain non-resident and non-resident alien hunter harvest summary, 1998. Manuscript Report No. 120, Dept. of Resources, Wildlife & Economic Development, Norman Wells, NT. 31 pp.

Veitch, A.,Popko, R. and Whiteman, N. 2000c. Classification of woodland caribou in the central Mackenzie Mountains, Northwest Territories, August 1999. Dept. of Resources, Wildlife & Economic Development Manuscript Rep. No. 122, Norman Wells, NT. 13 pp.

Veitch, A, Simmons, E., Promislow, M., Tate, D., Swallow, M, and Popko, R. 2002. The status of mountain goats in Canada's Northwest Territories. Northern Wild Sheep and Goat Council 13: 49-62.

Yukon Renewable Resources. 1996. Sheep management guidelines. Dept. of Renewable Resources, Yukon Territorial Government, Whitehorse, YT. 10 pp.

APPENDIX 1. Outfitters licenced to provide services to non-resident hunters in the Mackenzie Mountains, NWT – 2005

D/OT/01 – *SOUTH NAHANNI OUTFITTERS LTD.*
Werner Aschbacher and Sunny Petersen
PO Box 31119
Whitehorse, YT Y1A 5P7
Ph: (867)-399-3194
Fx: (867)-399-3194
e-mail: info@huntnahanni.com
website: www.huntnahanni.com

D/OT/02 – *NAHANNI BUTTE OUTFITTERS*
Cam and Clay Lancaster
PO Box 653
Hudson Hope, BC VOC 1VO
Ph: (250)-783-9197
Fx: (403)-380-6126
e-mail: claykris@pris.bc.ca
website: www.lancasterfontana.com

G/OT/01 – *ARCTIC RED RIVER OUTFITTERS*
Kelly and Heather Hougen
P.O. Box 5988
Whitehorse, YT Y1A 5L7
Ph: (867)-633-4934
Fx: (867)-633-4934
e-mail: info@arcticred-nwt.com
website: www.arcticred-nwt.com

S/OT/01 – *GANA RIVER OUTFITTERS*
Harold Grinde
P.O. Box 528
Rimbey, AB T0C 2J0
Ph: (403)-783-3499
e-mail: ganariver@telus.net
website: www.ganariver.com

S/OT/02-*MACKENZIE MOUNTAIN OUTFITTERS*
Stan and Helen Stevens
P.O. Box 5
Tomslake, BC V0C 2L0
Ph: (250)-786-5118
Fx: (250)-786-5118
e-mail: stevens.mmo@pris.bc.ca
website: www.mmo-stanstevens.com

S/OT/03 – *RAM HEAD OUTFITTERS*
Stan and Debra Simpson
P.O. Box 89
Warburg, AB T0C 2T0
Ph: (780)-848-7578
Fx: (780)-848-7550
website: www.ramheadoutfitters.com

S/OT/04 - *NWT OUTFITTERS*
Eric Mikkelson
PO Box 106
Lazo, BC V9N 8Z8
Ph: (888)-293-2299
Fx: (250)-897-0054
e-mail: huntnwt@shaw.ca
website:
www.wildsheep.org/nwtoutfitters

S/OT/05 - *REDSTONE TROPHY HUNTS LTD.*
P.O. Box 18
Pink Mountain, BC
VOC 2BO
Ph: (250)-772-5992
Fx: (250)-261-9962
website: www.redstonehunts.com

APPENDIX 2. Summary of fees, bag limits, and seasons for big game species available to non-resident in the Mackenzie Mountains, NWT - 2005. [Note: all prices are in Canadian funds.]

Species	Status	Tag Fee	Trophy Fee	Bag Limit	Season
Black Bear	Non-resident	$20	$100	1 adult bear not accompanied by a cub	15 Aug - 31 Oct
	Non-resident alien	$50	$100		15 Aug – 30 June
Woodland Caribou	Non-resident	$20	$200	1	25 Jul - 31 Oct
	Non-resident alien	$50	$200		
Mountain Goat	Non-resident	$20	$200	1	15 Jul - 31 Oct
	Non-resident alien	$50	$200		
Moose	Non-resident	$20	$200	1	1 Sep - 31 Oct
	Non-resident alien	$50	$200		
Dall's Sheep	Non-resident	$20	$200	1 adult male with min. ¾ curl	15 Jul - 31 Oct
	Non-resident alien	$50	$200		
Wolf	Non-resident	$20	$100	1	15 Aug - 31 May
	Non-resident alien	$50	$100		25 Jul - 10 Oct
Wolverine	Non-resident	$20	$100	1	15 Aug - 31 Oct
	Non-resident alien	$50	$100		25 July - 31 Oct

Source: Department of Environment and Natural Resources. 2005. Northwest Territories Summary of Hunting Regulations. Department of Environment and Natural Resources, Yellowknife, NT. 26 pp.

APPENDIX 3. Comments provided from non-resident hunters in the Mackenzie Mountains, NWT on voluntary Hunter Wildlife Observation Report forms, 2005. We have not printed actual names of outfitters or their personnel (XXX).

Didn't show up due to problems with his job in Germany.
Stop hunting due to back problems.
Did not recover goat fell into cliffs and could not get to it with ropes.
No kill weathered out foot and a half of snow. Weather conditions unfavourable.
Better if could hunt grizzly bear.
Had to leave early family emergency.
Very nice country
This was a great experience from all points of view. We saw many up and coming rams that looked to be in great condition,
Excellent scenery and clean - Just the way that country deserves to stay (keep out mining and oil and gas!)
The overall experience was great. XXX and the guides of XXX went well out of their way for the comfort of their hunters.
Our total hunting experience from Norman wells to our return was very professional. XXX and his crew go out of there way to make your hunt a total enjoyable experience. They take the time to explain the habitat, animals, migrations etc, and game laws pertaining to our hunt.
Hunter shot wrong ram, 3/4 curl.
Sheep was in good healthy condition, 10 year old ram, no teeth missing.
Rams lungs were discolored and full of hard cysts. Left lung was fused to rib cage by scar-tissue.
Ram was otherwise in good physical condition.
Ram had bad case of lump-jaw.
Ewe:lamb ratio was excellent (3:2)
It was a great hunt! Hopefully I will return.
Big wide open area, great hunting experience.
Excellent outfitter and lots of game. Would not even consider hunting Dall's sheep anywhere else. Ram was in good condition, no abnormalities. Caribou was also in good condition, very healthy looking.
Excellent outfitter and hunting experience. Time to harvest some grizzly's.
Wolves were very aggressive, one big grey bluffed (charged) to 15 feet. Great area.
Excellent hunting experience.
XXX was excellent + I would love to hunt with them again!
The area was great. XXX is an outstanding outfitter. I had the best hunt of my life!
Caribou in good condition no abnormalities. Sheep in good shape but old (12 years) missing teeth and loss of hair.
Great Hunt!
Caribou in good condition, no abnormalities found.
Caribou was in good healthy condition, no abnormalities.
120 Caribou spotted mixed 20/80/20 bulls/cows/calves. Saw 4 grizzly bears- 2 Sows and 2 cubs (3 yr old). One grey wolf and one red fox also seen.
Seen lots of sheep, rams, ewes and lambs, all looked very good.
In every aspect the hunt/ outfit/ guide/ sheep/ system/ country/ food/ gear absolutely first class. Saw one ram 9.5 yrs old that still had winter hair. Feet were also grown out very long. Ram seemed very nervous, almost paranoid.
Beautiful country, very remote, loved the solitude.
Excellent hunt/ sheep numbers more than expected. Would like to return for moose.
Great outfitter - concerned about the game and the area.
Outstanding Outfitter! Great Hunt.
Enjoyed XXX and the hunt!
Saw lots of good sheep, Big country. Great hunt.
Great Hunt - will be back.

Wonderful.
Great hunts, lots of animals and hard work with long hours.
This is the most beautiful place in the world and I will surely be back.
good hunt, guides and pleasurable overall experience.
Beautiful country. Enjoyed the hunt. Saw a lot of game. I would recommend to anyone to come and hunt in the Mackenzie Mountains. XXX are 1st class.
Tremendous area, lots of game, beautiful scenery. Outstanding outfitter + guides. Best hunt I've ever had!
Great Outfitters / Guides/ Camp.
It looks you have a grizzly bear problem. Seen once chasing two moose calves, guide and one small bear.
Lot's of grizzly bears. Saw 7 in one day!
Too many grizzly bears!
Wonderful experience. The scenery alone is worth the trip. Exceeded our expectations. Great job by everyone at XXX.
Great hunt and great outfitter. Lots of high quality game, open the bear season, lots of grizzlies. Impressed with both quality and quantity of animals. Saw lots of sheep and only hunted one small area the entire trip.
Outstanding hunt and total experience - XXX folks are great!
I have hunted big game for 31 years and the Mackenzie Mountains and XXX are the best I have ever experienced.
XXX runs one of the very best hunting operations I have ever had the opportunity to hunt with.
Great bull, great guide, time of my life.
Great Hunt!
Need to thin the grizzly population down some.
I had an excellent hunt with XXX. The scenery was gorgeous + the game was plentiful! You should open it up to grizzly bear hunting!
1st class operations with very talented and informative help. Hope to come back soon.
Had a wonderful experience in this beautiful country. Was treated most graciously by the folks at XXX, a first class operation.
Excellent hunting experience.
Excellent Outfitter - XXX - XXX. Far sighted game management program. Method if hunting minimizes impact on game territories.
Most remote, wild place ever visited - beautiful.
Good Outfitter - guide - ram - Great hunt again!
Great country keep it pristine!!
Great hunt, great guides, good people, comfortable camp. Win, win as a hunter! Thank you!
Best hunt I ever had.
We had a great hunt. A super outfitter, guides and hunting experience.
Excellent weather, outfitter, guides, accommodations. Abundant game animals, beautiful mountain scenery.
Thanks – A great trip.
Some of the most awesome country that I've hunted in. It was a great experience, one that I will never forget.
Great
Excellent Outfitter!
As always a breathtaking experience with XXX and his crew. They must be the # 1 Outfitter in the Mackenzie's!
Hopefully the Government of the NWT will ensure that these mountains remain wild, without vehicle access other than by air. Keep out oil and gas exploration; they are destroying Alberta's wilderness areas.
Outfitter did an excellent job accommodating a personal health situation while still providing a taste of the wild west Northwest Territories. Such was much appreciated.
Gorgeous geography, top notch outfitter + guides at XXX -XXX.
There are far too many wolves in this ecosystem. Moose and caribou mortality appear to be, consequently too high. There are too many grizzly bears as well. I would recommend opening grizzly hunting to non-resident/aliens in this area.
Bow hunter
Grizzly got moose meat, except 10 pounds. On Sept. 3rd I shot a bull moose near O'grady Lake. We quartered him and cut up all back strap/tenderloin/ribs. We took tenderloin and back strap to camp. On the 4th we went back to get meat + horns + cape + while skinning the head an adult male grizzly charged us within 30 feet. He stood up and

chomped his teeth. We shot over him and he left. Then came back and left again. We saw he had buried the meat and we left with the cape and horns.
It was a great hunting experience including backpacking from the top of the mountains for sheep to horse packing for caribou. There were many grizzly bears seen from all members of camp! I would like to se a grizzly bear hunting season in the Mackenzie Mountains to help control the numbers!
It was an experience that was so incredible that it is hard to describe and do full justice.
Wolverine got all goat meat.
Incredible wilderness area, outfitter was excellent at protecting environment. Never saw any debris or abuse of environment during my miles of hiking.
XXX very accommodating - well run, professional first class staff.
Open the grizzly bear season to non-residents, The amount of sign indicates a very high population of GB's as well as the number seen.
Great time.
Great hunt - impressed with number of sheep and caribou.
Excellent hunting and trophies, and return there next year.
Excellent hunting, animals and outfitter team.
No need to return, accomplished what I wanted by taking a P & Y Mountain Caribou
Excellent quality of animals in this area.
Good quality animals
I was caribou hunting, we did not see large numbers of caribou. We saw only 2 large bulls (350+). This could have been due to weather (very hot) or smoke (the air was very smoky from forest fires)
Numbers, and quality looks healthy. Grizzlies seem to be a problem. Client is a guide. Took his 44 lbs out with him trailing horses.
Dall's sheep herds look good and healthy. Areas with sheep and caribou had good numbers.
Excellent population of sheep. Many good mature rams. Saw only one group of ewes and lambs, but wasn't really looking for them or lambing areas. Excellent guides very concerned about good conservation practices and preservation of hunting areas.
After several days of being weathered in I finally got to see an abundance of game. Saw many sheep and felt overall numbers were good and healthy. Bear problem at camp.
All animals looked healthy. In quantities we saw many caribou and calves and sheep.
Looked fine lots of calf caribou.
Game was plentiful and good quality.
I had an awesome experience; lots of game (sheep, caribou and moose) harvested a nice healthy ram.
All the animals I observed were in good condition. Did not see any unusual conditions.
All of the animals I observed on this trip appeared to be in good condition.
A tremendous amount of sheep. A good number of caribou present.
Very remote country. It was a pleasure to hunt. Great outfitter.
The wolf I shot, teeth were almost worn out.
Lots of sheep, all animals in excellent condition, beautiful country.
I saw many sheep and caribou and took 2 trophies and more
Game animals in good condition - good numbers lots of bears.
Ram quality excellent. Large, healthy (fat!) rams. Good numbers. Caribou not into area yet. Some in but not tremendous amounts. Bull I killed was in excellent shape, good teeth and mature.
Caribou were just starting to move into the areas we were in. I saw quite a bit of sheep when the weather was not bad.
Saw plenty of game in four days of hunting.
Very good hunting. Great Outfitter.
Quality good, quantity fair to good, condition very good.
Everything fine nothing unusual noted.
Game was not moving like we'd hoped for. Weather probably to nice.
Had a great experience! Excellent guides - saw fair amount of game just not the right ones.
Beautiful area, saw much game, great trip!
The caribou didn't move to much, except for one day when it seemed they were all over.

Health and quality seemed to be excellent.
Quantity was adequate, big herd, not moving yet. Game seemed to be in great condition. Saw lots of predators.
Nothing unusual - Well satisfied.
There were no unusual conditions noticed on the animal. We observed many good animals throughout the hunt.
Saw lots of moose/caribou and sheep all good quality and in good shape.
Great hunting, guides! Even I shot a caribou. Beautiful country.
Wonderful total experience - superb guides, operation and facilities would highly recommend to anyone. Fabulous country plentiful game, great camp + personal - unforgettable experience.
Had a great hunt!
No game taken.
Saw lots of good game, beautiful country. Unfortunately just didn't find the one I was looking for. I will be back.
Wonderful hunting experience.
Overall we had a great experience, saw lots of game however not many mature rams. We had too many travel days that limited our ability to get our rams. Our guides were very courteous and helpful.

APPENDIX 4. A summary of the 2005 voluntary hunter comments broken down into specific topics.

No. of hunters reporting	No. of hunters mentioning good quality hunts	No. of hunters mentioning abundance of animals	No of hunters mentioning grizzlies	No. of hunters mentioning wolves	No. of hunters mentioning bad weather
131	46	26	16	5	4

APPENDIX 5. Number, age, and horn length measurements of Dall's sheep rams harvested by non-resident hunters in the Mackenzie Mountains, 1967-2005.

Year	Number of Sheep Harvested	Age (Years)		Length of Right Horn	
		Mean	Sample Size	Mean (cm)	Sample Size
1967-1968	223	8.4	Unknown	86.4	168
1969	110	-	-	-	-
1970	94	-	-	-	-
1971	88	-	-	-	-
1972	110	8.5	96	86.2	90
1973	89	8.9	86	84.4	88
1974	93	9.2	85	88.6	91
1975	129	7.6	67	84.6	127
1976	144	7.8	46	88.0	144
1977	132	5.7	69	86.8	132
1978	187	8.5	115	88.9	165
1979	200	8.7	108	90.7	154
1980	180	-	-	89.9	127
1981	187	8.1	101	93.7	157
1982	126	8.7	98	89.7	124
1983	100	9.0	80	90.9	94
1984	102	8.4	98	91.2	99
1985	123	8.1	115	89.7	112
1986	154	8.8	132	88.4	153
1987	148	8.9	148	89.4	148
1988	177	9.8	166	91.7	161
1989	207	9.9	199	90.4	203
1990	219	9.8	200	90.2	218
1991	170	9.7	161	89.1	170
1992	203	9.7	199	88.0	202

APPENDIX 5 (CONT.) - Number, age, and horn length measurements of Dall's sheep rams harvested by non-resident hunters in the Mackenzie Mountains, 1967-2005. Number harvested includes [1]10 and [2]2 harvested by resident hunters.

Year	Number of Sheep Harvested	Age (Years)		Length of Right Horn	
		Mean	Sample Size	Mean	Sample Size
1993	191	9.7	181	87.6	190
1994	199	9.5	191	89.8	196
1995	190	9.7	189	89.3	189
1996	201	9.5	200	88.7	201
1997	210	10.0	206	89.9	203
1998	215	10.0	207	90.0	209
1999	204	10.2	183	88.8	184
2000	189	10.0	189	89.5	189
2001	199	10.0	188	87.7	189
2002	173	9.9	166	89.2	166
2003	213	9.7	210	89.8	212
2004	201[1]	10.0	199	89.3	200
2005	203[2]	10.2	196	89.4	199

APPENDIX 6. Summary of age and sex ratios calculated from non-resident hunter observation reports in the Mackenzie Mountains, 1995-2005.

Year	Dall's Sheep		Woodland Caribou		Moose	
	Lambs: 100 Ewes	Rams: 100 Ewes	Calves: 100 Cows	Bulls: 100 Cows	Calves: 100 Cows	Bulls: 100 Cows
1995	67	82	36	34	30	95
1996	44	82	45	40	26	76
1997	57	55	36	21	30	107
1998	60	84	36	34	30	95
1999	58	90	43	25	20	100
2000	47	90	41	39	26	89
2001	59	89	56	61	28	120
2002	58	89	59	31	29	96
2003	50	83	39	36	25	129
2004	53	93	42	38	30	101
2005	51	98	42	42	33	110
Mean 1995-2005	55	85	43	36	28	102

APPENDIX 7. Outfitted non-resident hunter harvests in the Mackenzie Mountains, 1991-2005.

[1] Includes 10 harvested by resident hunters; [2] Includes 2 harvested by resident hunters.

Year	Number of Licences Sold	Number of Animals Harvested					
		Dall's Sheep	Woodland Caribou	Moose	Mountain Goat	Wolf	Wolverine
1991	354	170	179	40	6	14	3
1992	364	203	142	32	4	7	0
1993	382	191	191	56	9	7	3
1994	356	199	164	46	5	15	2
1995	344	190	180	49	6	14	1
1996	387	201	175	46	4	11	4
1997	352	210	168	44	2	17	1
1998	345	215	160	52	5	9	0
1999	321	204	117	36	1	11	3
2000	332	189	127	44	1	14	0
2001	339	199	132	47	2	15	2
2002	329	173	168	42	5	11	1
2003	347	213	143	48	6	12	0
2004	337	201[1]	135	55	6	18	0
2005	394	203[2]	160	74	18	19	1
Mean 1991-2005	352	197	156	47	5	13	1